spect for even sanitary habitations, and their occupants will no longer be immune.

I shall close this paper with one other observation: Rat infection in San Francisco, while it has never been extensive, has borne a striking analogy to the infection in human beings, and plague cases occur in places where infected rats have been found; in one instance dead plague rats and a dead human victim being found in the same room.

It has been found in the application of sanitary measures in various places that poisoning rats, disinfecting, medical inspection, etc., while they are very important auxiliaries, are not nearly so effective as the tearing out of filthy habitations and the reconstruction of such buildings on good sanitary principles. This kind of work goes far toward getting rid of the rat by alteration of environment, and at the same time decreases the chances of infection from such as remain, inasmuch as the rats will seek the darker recesses of the building, and in this way will not come in contact with its human occupants nearly so frequently as they do in the close, dark rooms of many of our present buildings in Chinatown. Not only this, but it has been repeatedly noted that the danger of contracting plague from infected rats is very much lessened when the contact with the rat is in a pure atmosphere, just as it is with human cases.

REFERENCES:

1. Zieman. Journal of Tropical Medicine, Jan. 1, 1903.
2. Schilling. Journal of Tropical Medicine, Feb. 2, 1903.
3. Manson. Journal of Tropical Medicine, March 16, 1903.
4. Castellani. Journal of Tropical Medicine, June 1, 1903.
5. Editorial. Journal of Tropical Medicine, Nov. 1, 1902, and July 15, 1903.
6. Dutton. British Medical Journal, Sept. 20, 1902.
7. Manson. British Medical Journal, Sept. 19, 1903.
8. Cantlie. British Medical Journal, Sept. 26, 1903.
9. Francis. Bulletin No. 11, Hygienic Laboratory, U. S. Public Health and Marine-Hospital Service.
10. Cobbold. Intestinal Parasites.
11. Thomson and Thomson. Treatise on Plague.
12. Creighton. History of Epidemics in Great Britain, vol. 1.
13. Montenegro. Bubonic Plague.

THE CONTINUANCE OF PLAGUE IN SAN FRANCISCO.*

By W. C. HASSLER, M. D., San Francisco.

On February 29th, 1904, the last verified case of bubonic plague was noted by the Department of Health. During all of the period prior to the reporting of the first case in 1900 and up to April 18, 1906, active measures were continued looking to the sanitation of the city, particularly that area then accepted as the infected section of the city, to wit: Chinatown and North Beach; and while these active measures, which included catching and poisoning of rats, from 25 to 50 of which were examined daily in the bacteriological laboratory for infection, and the spreading of chloride of lime and carbolic solution over those areas considered suspicious and dangerous, by reason of infection having existed thereon, it is but natural to assume that the fire of April 18th and days following thoroughly eradicated any foci that remained hidden in these sections or adjacent areas and that the city might have reason to believe it had eliminated bubonic plague from its midst.

A review of the situation will, however, immediately present proofs that this city can never assume that it will remain free of infection so long as the disease exists in foreign ports, which have communication by steamship and other transportation facilities with the city and said places.

The question of interest, however, at the present time, centers upon the continuance of plague in San Francisco, excepting only that interval that occurred between 1904 and May 27, 1907, and the fact to be established is: was the infection dormant during the period of this time or was the city really clean and free of the disease; and was it reinfected from outside sources, which may have been from one or two points?

To consider the first proposition, we know that the bacillis pestis, in favorable soil, will remain active for many months; it having been stated by some writers and investigators to be many years. Had not that portion of the city where the infection originated been totally destroyed, the present epidemic might be attributed to reinfection from internal foci; but the fact that no case had occurred for so long a period of time and that the infection was not found in the hundreds of rats examined during the period, it would seem that the source of the recurrence must be looked for among the outside factors, which are two-fold.

Infection might occur at any time from rats brought to this port by foreign ships, infecting those rats that find their habitat along the water front. Secondly, the infection may have come from the bay counties adjacent to San Francisco which had not observed the sanitary precautions that San Francisco had and which were never entirely free from the disease or its menace to further spread; as was instanced in the case of the boy infected with bubonic plague, unquestionably contracted by having been bitten by a wounded squirrel, shot by him while hunting in the Contra Costa hills.

Infected rats would find it easy to travel back to San Francisco from those points along the eastern shores of the bay by means of the vessels receiving and discharging cargo between the respective points. Or, it would be possible to infect the river boats and tugs plying between San Francisco and other bay points, which in due time would become foci for the distribution of the shore rats to San Francisco.

This is but one aspect of the infection from the bay counties. It is quite possible that San Francisco was reinfected from points further distant, as the history of the first case noted in 1907 would indicate, to wit: Oscar Tomie, a sailor on the steam tug "Wizard," which plied between San Francisco,

* Read before the California Academy of Medicine, November, 1907.

Mendocino County and as far south as San Luis Obispo.

Oscar Tomie had been regularly employed on this vessel for some six weeks prior to his illness and had not left the vessel until May 27th, when he was taken to the Marine Hospital, after having passed one night on shore, prior to his going to the hospital, where he died two days later of bubonic plague.

The vessel during this period was on a trip north and foundered before arriving at her destination; hence it is impossible to say, definitely, whether infected rats existed upon her.

The crew of the ill-fated vessel arrived in San Francisco some weeks later, all in a healthy and normal state, but had nothing of their effects except the clothes they had on at the time the vessel sank.

The "Wizard" had been tied alongside of a vessel that had arrived from Hilo, Japan, a few weeks prior to the sickness of the sailor Tomie, and as plague existed in Honolulu at the time, it is as probable that this vessel was infected by rats from the Hilo ship, as it is that the vessel was infected by local bay rats.

All of the foregoing are problems to be considered in the analysis of the present situation, it being an established and recognized fact that bubonic plague is spread principally to uninfected areas by means of the rat.

The present epidemic had its original focus adjacent to the water front, and that isolated foci are scattered over the city irrespective of location, class of residence, soil and character of individual is not a peculiarity of the epidemic, but a necessary result of virulent infection brought to a particular locality, and the sooner this fact is established and recognized the better it will be for the general welfare of the inhabitants of this city.

I say this because of the indifference manifested by the hundreds of individuals; even in the ranks of our own profession we still find doubters that plague exists and optimists that claim plague will never attack the white race of this city by reason of our trade winds, particularly favorable location, etc.

The original nidus is, or has enlarged to the extent that its scope now extends over the entire bay frontage and a goodly portion of the central part of the city, with a fair promise of spreading to the extreme limits of the county.

At the original foci we find upon close survey the following conditions: First, a class of people while in the main clean and given to much scrubbing and washing, on the other hand ignore all laws of hygiene regarding ventilation and cubic air space in their sleeping apartments. This class is in part the same that existed in this locality prior to the fire, but differ from the type who lived here in former days, and is distinctively higher class than usually characterizes water front inhabitants, or what might be construed by the use of the term "Water Front." They are generally careless in the disposal of their waste and refuse; being rather inclined to accumulate and hoard all manner of garbage pickings, which in part is utilized to feed the goat, chickens and other fowl kept by them, and in part disposed of as junk.

In addition to this we have a sandy surface soil that will vary in depth from 6 inches to many feet before an impervious layer of clay is reached and which in the main is dry and forms an ideal incubator for the hatching and propagation of fleas and other vermin, which are the intermediate host between the rat and the human.

Owing to the complete destruction wrought in the city in 1906, there resulted, generally speaking, two things: first, an almost complete reversal in the manner of living among those deprived of homes. Shacks, tents and nondescript houses sprang up singly and in groups like mushrooms on a dunghill. The latrine replaced the former toilet that had sewer connections, and in hundreds of instances the latrine was even lacking, night soil and discharges being thrown on the surface ground because the requisite manual labor necessary to construct a latrine was considered a waste of time and energy; garbage and kitchen waste was disposed of by burial, or more likely by dumping on to some neighbor's property, or if not, into the public street or corner cesspool.

With this, the individual sanitation fell so far below par that it was or should be placed at zero in the scale. This was due to the difficulty or inconvenience in obtaining water; for, I believe, that no matter how low the individual is rated, if running water is at hand he will use it, but will in no wise allow his equanimity to be disturbed by dirt if its removal costs more than a few yards' walk, and what holds true of individuals, is likewise applicable to groups.

Next to be considered is the primary host, "the rat." It has been remarked by many that the great fire destroyed thousands of rats. This is no doubt true, but those whose duty it was to work on the fire line will bear witness to the fact that as the fire spread it was preceded by an army of rats, which with almost human perception recognized the danger and fled to the zone beyond.

Unquestionably, many perished in the walls of buildings or in the merchandise contained therein, but the ratio of death is low compared to the numbers then existing.

The sequence of this was an overcrowding of the new sections of the city that already had their quota of rats, for it may be taken as a fact that every part of any city will always have just as many rats as that section can supply food for, minus the number destroyed by poison, trap or other means by the the residents thereof.

In this migration, was there a transmission of infection from the lower section of the city? This is a debatable question that might be argued pro and con and which will be left open for discussion, bearing in mind the fact that it was 25 months after the fire that we registered our first death from plague.

In connection with this, I present a factor, to wit: plague is often passed unrecognized by the general

practitioner. This is particularly true of the pneumonic types and a review of the vital statistics for the year May 29th, 1906, to May 29th, 1907, shows that there were in all 748 deaths from pneumonia, only 463 of which were reported prior to death by physicians. The death certificates show that these cases ran an extremely short course and that the majority occurred among the lower classes. This may or may not be looked upon with suspicion in view of later developments.

These two points, to wit: the possibility of the old infection being transmitted into the new section of the city and that many of the cases passed unrecognized prior to May 27th, will be left to debate for final settlement and another aspect of the situation be given for your consideration; namely, the rat driven from its original haunt into the new section of the city was, by force of natural instinct and circumstances, desirous of a return to its original haunts on the abatement of the causes that had driven him out, to wit: the earthquake and fire.

Here, by reason of the lack of vigilance on the part of the authorities in permitting foreign vessels to dock without the safeguards, namely, ratguards and fenders, or perhaps by contact with infection from rats of local bay points, they became infected with the bacillis pestis.

Food being scarce and the conditions generally greatly disturbed, it was but natural for the rat to return, if only as a visitor, to the section where he had been temporarily housed, and found convenient pickings and safe harboring place beneath the wooden floors of the hundreds of small and unsanitary stables that exist in the area contiguous to the burnt district, leaving perhaps his dead body or transmitting the infection to the rodents of the locality, which in turn are carrying this infection from one point to another over the entire city.

Coincident with the present outbreak, the city has been suffering from an epidemic of fleas. While this pest is always with us, it has been exceptionally numerous during the last summer, and as it is principally through this medium that plague is transmitted to the human, it therefore is second only in importance to the rat which is the primary host.

From experimental sources we believe that the bacillis pestis remains active in the flea for about 7 days. Whether it is transmitted from one flea to the other has not been entirely proven, but positive proof exists of the transmission from rat to flea and from flea to human.

This epidemic of fleas may be accounted for in various ways. First, there was an unusual amount of dust and dirt distributed over the city in the process of cleaning away the debris and ruins. Second, streets and sidewalks were for months unswept. Third, there was an overcrowding of the new business and residence section, which as a result did not have the conveniences or the time requisite for the usual thorough cleansing. Fourth, the public conveyances and street cars were likewise overcrowded and dirty, which, with the changed conditions of living, created a condition favorable to the hatching and propagation of fleas.

What influence all such conditions have on the spread of the infection, though problematical, should not be lost sight of in the analysis of this situation nor in the ultimate sanitation thereof. The consideration of this latter, when all is said and done, remains as the most important in the eyes of the layman.

The plan at present energetically carried on is unquestionably the right one and if our citizens can be duly impressed with the seriousness of the menace and the necessity for their response and help in the sanitation of individual premises and the fight against the rat and the flea, it can be but a question of months when this peninsult will be entitled to a clean bill of health.

In this work none can aid as much as the family physician or medical adviser, if he will but consider it a part of his professional duty to his patients.

The slogan of this campaign is "THE RAT MUST GO!" This is accomplished first by destroying his home; second, by cutting off his food supply, and third, by poisoning and catching him if he still finds a lodging place or persists in remaining in the neighborhood.

The Board of Health is actively engaged in the destruction of his home by the condemnation of all stables having wooden floors and improperly constructed manure and feed bins. But this procedure is slow and cumbersome under the existing laws, and to overcome this an ordinance is about to be proposed that covers this detail and which if passed will remedy the evil now existing in stables.

The second measure spoken of, to wit: cutting off the food supply, is perhaps the most important, for even with a home, the rat must starve or leave the locality if it cannot obtain food, and in a city situated as San Francisco, this should be a municipal problem and so regulated that the burden of cost and removal of garbage, which is the natural food of the rat, be taken care of by the city instead of the manner at present employed.

This problem could be very easily solved by placing the burden of removal of house refuse and garbage upon the property owner and not upon the tenant. In fact, the cleaning of the streets and the removing of garbage, refuse and manure should be under the jurisdiction of either the Board of Works or Board of Health. This would insure getting all of the garbage and waste and would produce a state of cleanliness not obtainable under existing conditions. For the adoption of such a plan every physician should lend his aid and influence.

Next in importance to the eradication of the rat is the obliteration of the refugee cottage, an evil which will cost the city many thousands of dollars before it is rooted out. That section of North Beach, with all the contiguous area, is especially menaced by these cottages, and with the notorious favorable surface soil for the hatching of fleas, the lack of general sanitary conveniences makes this our most important field for work. The cottages should

be routed out, and especially should this apply to the section from Presidio to the Park between 13th and 14th avenues, Lobos Square and Telegraph Hill vicinities, where they should be vacated, destroyed and grass plots made of the surface areas.

The installing of a salt water system would insure us not only against fire, for which it would be primarily intended, but afford an abundant supply of water for the sprinkling of streets and the flushing of sewers.

AMPUTATION BELOW THE KNEE JOINT.

By ANDREW M. HENDERSON, M. D., Sacramento.

Although the technic of amputation is well understood and the performance of the operation is generally considered simple, none the less the results vary so greatly that we cannot but feel that there is good reason for giving some time to consideration of the various details. This operation does not always come to the surgical specialist. The occasional operator or physician less accustomed to operative technic may find himself forced to perform the operation and under circumstances far from favorable for obtaining ideal results. Unless he is mindful of the essential points in the detail of the technic, he is quite likely to realize some of the difficulties of the procedure before the patient obtains a satisfactory artificial limb.

The first aid given to patients suffering from injuries which are likely to result in amputation is a very important factor in the result. The limb is quite likely to have dirt and gravel ground into the soft parts. The soft parts are contused and lacerated, a condition most favorable for accepting the infection to which they are greatly exposed. The limb should be bared and cleaned as well as the circumstances will permit. A moist antiseptic dressing should then be applied, to serve as a protective dressing as well as to render the exposed parts sterile. To control hemorrhage, unnecessary force must not be used. Frequently a compress applied without great force may be sufficient. If a vessel is exposed it should be clamped to check the flow of blood.

It may be necessary to apply greater force in such a manner as by application of a tourniquet. When such is the case the attendant must use some judgment as to the location of the tourniquet. The force should be applied as near to the extremity as possible, and should be no greater than is necessary to control the bleeding. These suggestions might seem unnecessary were I not to explain that during the last two years I have seen several cases brought to the hospital without any effort having been made to cleanse the injured parts, but with a tourniquet bound tightly around the limb at the site to be chosen for amputation. It is not uncommon to have these patients enter the hospital crazed by alcohol, as much as a quart bottle of whisky having been given to the patient in transit to the hospital. A patient in such a condition is not a fit subject to be given an anesthetic, nor is he capable of listening to reason relative to the procedure to be undertaken. When alcohol is given it should be within reasonable limit. Strychnin is a better stimulant, and morphin a better anodyn. The decision as to final course of treatment is frequently very difficult. There has been considerable discussion as to the propriety of the different amputations of or through the foot.

Every surgeon has at some time questioned the propriety of sacrificing so great a part of the limb when it might seem that an amputation through the foot might suffice. It is not to be wondered that the patient opposes such advice.

C. B. Clapp, of Moberly, Mo., has recently reported the replies of 96 surgeons and 35 limb makers to questions as to the advisability of making various amputations through the foot, and as to the ability of the limb makers to provide artificial limbs for such stumps. A considerable majority, both of surgeons and of limb makers, advised the Lisfranc operation when such is possible; however, a very respectable minority opposes even this operation. The Chopart, Pirogoff, Symes and the operations through the foot were advised against by a large majority of surgeons as well as limb makers, because of the inability of the stump to bear the weight of the body and the impracticability of adjusting a useful artificial limb. In answer to the question as to the selection of site for amputation when the foot must be sacrificed, most of the surgeons and all of the limb makers advised a point from 8 to 9 inches below the lower border of the patella. In questioning men wearing artificial limbs, I have generally found those best satisfied whose limbs have been amputated at this point.

In a case where the foot is crushed and the tissues of the upper part of the leg are not bruised, it becomes possible for us to select the method of operation. The preliminary preparation of the limb should be of the most careful character. It should be washed thoroughly and the hair should be carefully shaved, and where it is impossible to cleanse the distal part thoroughly, it should be wrapped in sterilized cloths so as to prevent the soiling of the cleansed portion. I note this especially because of the tendency to hasten the preparation of the limb for amputation.

The tourniquet should be applied above the knee joint and kept in position until the flaps are adjusted, and such vessels as are easily located have been taken up. Under such circumstances we would advise the use of the long anterior and short posterior flap method, cutting the skin flap from without inward through the muscle to the bone, holding the knife in an oblique position so that the thinnest part of the muscular flap is nearer to the skin incision. It is well to make a periosteum flap, but it is useless to do so unless some of the muscular tissue is retained with the periosteum as the periosteum receives its blood supply from the muscular tissue. Having elevated the periosteum and retracted the muscles by means of the three tailed muslin retractor or similar device, the fibula is divided